

# CHAPTER 4

## RESIDENTIAL SUBDIVISIONS

### SECTION 4.1 INTRODUCTION

The purpose of these guidelines is to provide information required to prepare construction plans for residential subdivisions (single-family, two-family and townhome). Design standards for apartment developments may be found in Chapter 5 – Commercial Subdivisions.

### SECTION 4.2 CONSTRUCTION PLAN SUBMITTAL

The following plans shall be submitted to the Public Works Department:

- Cover Sheet
- Storm Water Management Site Plan (scale no smaller than 1" = 100')
- Storm Water Pollution Prevention Plan – During Construction (scale no smaller than 1" = 100')
- Storm Water Pollution Prevention Plan – Post Construction (scale no smaller than 1" = 100').
- Water and Sanitary Sewer Plan
- Sewer Profiles (horizontal scale 1" = 20' or 1" = 40', vertical scale 1" = 4')
- Water Profiles, as required (horizontal scale 1" = 20' or 1" = 40', vertical scale 1" = 4')
- Paving Plan and Profile (horizontal scale 1" = 20' or 1" = 40', vertical scale 1" = 4')
- Median Opening/Auxiliary Lane Plans, as required
- Drainage Area Map (scale no smaller than 1" = 100')
- Drainage Plan and Profile (horizontal scale 1" = 20' or 1" = 40', vertical scale 1" = 4')
- Streetlight Plan (scaled no smaller than 1" = 200')
- Subdivision Grading Plan (scale no smaller than 1" = 100')
- Signal Plan, as required
- Plat
- Pavement Marking Plan, as required
- Sidewalk Connectivity Plan, as required (scale no smaller than 1" = 100')
- Applicable Details

Preliminary submittals shall include three sets of full size plans (22" x 34") for distribution within the City. Once the plans have been reviewed and accepted by the City, the engineer shall submit two full size and four half size sets of the plans released for construction. The plans must be prepared by a licensed civil engineer.

## **SECTION 4.3 ENVIRONMENTAL MANAGEMENT**

### **A. Storm Water Management Site Plan (SWMSP) – Permanent Controls**

#### **1. General Requirements**

A Storm Water Management Site Plan (SWMSP) shall be prepared for projects that meet the following conditions:

- disturb a surface area of 12,000 SF or more, and
- create or add 5,000 SF or more of impervious surfaces

The SWMSP shall identify permanent site features and controls that will be included in the design and constructed with the project to minimize and mitigate the project's long-term effects on storm water quality and quantity. A preliminary SWMSP shall be submitted with the plat in accordance with Section 6.2 of the Subdivision and Development Ordinance. The SWMSP shall be submitted with the paving and drainage plans.

The SWMSP shall be developed and coordinated with the site drainage plan and may be shown on the same sheet. It shall also be coordinated with the landscaping plan to prevent conflicts and assure compatible land use. The SWMSP shall meet all criteria of the SWMSP Checklist found in Appendix A and be sealed by an engineer.

#### **2. Permanent Best Management Practices (BMPs)**

It is the responsibility of the engineer to design BMPs that address site specific conditions using appropriate design criteria for the North Central Texas region. The NCTCOG Best Management Practices shall be referenced in the SWMSP, unless another source of design criteria has been specifically approved by the Public Works Director.

The following minimum number of BMPs shall be provided:

**BMP Requirements\***

<b><u>Area Disturbed</u></b>	<b><u>No. of BMPs (minimum)</u></b>
12,000 SF ≤ Disturbed Area < 5 acres	1
5 acres ≤ Disturbed Area < 10 acres	2
10 acres ≤ Disturbed Area < 20 acres	3
≥ 20 acres	4

\*Subdivisions with paved alleys, private access easements, or private streets shall provide at least one BMP above the minimum.

The following items are acceptable permanent BMPs for subdivisions:

- a. Preservation of natural creeks – Refer to Article 6, Drainage and Environmental Standards, in the Subdivision Regulations for requirements when preserving natural creeks.
- b. Site layout – Site layouts should be designed to require the least modification to existing topography and drainage. Factors to be considered are lots oriented and designed to minimize change in grade, drainage systems designed to minimize change in time of concentration, and street layouts designed to minimize extent of pavement.
- c. Retaining walls - When the final grade at a site is steeper than three horizontal to one vertical, up to two BMP credits will be given for retaining walls that are used for slope stabilization. To receive credit, the retaining walls shall be constructed before completion of the paving and drainage improvements and prior to the issuance of a building permit to qualify for credit.
- d. Vegetated swales – Vegetated swales may be used if drainage design criteria are met. Consideration will also be given for the use of vegetated bar ditches for local rural streets. When designed as a permanent BMP, vegetated swales shall be designed with a trapezoidal cross section and a gentle slope that yields a maximum velocity of 2 fps for the 2-year storm event. The engineer shall evaluate flow depths to verify no upstream flooding is caused by the vegetated swale during larger events.
- e. 100-year drainage easement – Dedication of the unaltered, 100-year, fully-developed flood plain as a drainage easement with the creek left in its natural condition will receive two BMP credits. This BMP credit is only available when no credit is being given for dedication of a linear park. Additionally, no credit will be given for preservation of a natural creek when credit is given for this item.

- f. Cluster design – The subdivision shall concentrate residential density in one portion of the site in exchange for other areas permanently dedicated to open green space, passive or active recreational amenities, or similar use. Credit will not be given for drainage and utility easements or space set aside for future development. Depending on minimum lot size, this BMP may require a Planned Development (PD) or utilization of the “D” option as outlined in the Zoning Ordinance.
- g. Detention - Detention may be achieved by surface ponds or subsurface structures. The first half-inch of runoff from the drainage area shall be detained and slowly released over at least 24 hours and preferably 40 hours or more. Detention ponds and structures shall be evaluated for the 5- and 100-year storm events to verify that no structure flooding will be caused by the detention. Outfalls for detention ponds shall be designed to prevent clogging of the intake. The pond shall also be designed in accordance with other criteria in this chapter.
- h. Retention ponds – Retention ponds may be used if the engineer can show that daily flows, ground water seeps, or other water sources are available to maintain a permanent pool with a healthy aquatic community. A water balance shall be submitted with the plan. Retention ponds shall be a minimum of 4 feet deep, have a 10H:1V slope for areas that are 1 foot deep or less, and be designed to prevent short-circuiting. Fountains, cascades, or other means of aeration shall be provided to prevent the pond from becoming stagnant. The pond shall be evaluated for its effect on the 5- and 100-year storm events to verify that the pond will not induce flooding.
- i. Preservation of existing tree canopy – This BMP is only available when the existing tree canopy covers more than 50% of the site. A minimum of 75% of the critical root zone shall be preserved at natural grade, with natural ground cover. The Storm Water Pollution Prevention Plan for construction activities must contain fencing requirements at the tree’s drip line to ensure preservation of the trees. In addition, the grading and utility plans shall result in no soil disturbance or change of grade within the drip line edge of the preserved trees. BMP credits will be given in accordance with the following:

<b><u>Percent of Existing Canopy Preserved</u></b>	<b><u>No. of BMP Credits</u></b>
25% - 49%	1
50% - 65%	2
> 65%	3

- j. Dedication of a linear park - Dedication of a linear park will count for two BMP credits. If the linear park encompasses the unaltered, 100-year flood plain, with the creek left in its natural condition, three BMP credits will be granted.

- k. Semi-pervious pilot channel paving – Alternative manufactured channel linings may be used instead of concrete paving in accordance with Article V, Drainage and Environmental Standards, in the Subdivision Regulations.
- l. Mixed use BMPs – For subdivisions that will support mixed use, refer to Chapter 5, Commercial Sites, of this manual for additional BMPs that may be used on the commercial list.
- m. Other BMPs – Other BMPs and innovative designs will be considered when submitted to the DPW with supporting calculations and references.

### **3. Construction and Maintenance**

The owner shall construct all permanent BMPs and is permanently responsible for maintenance of the BMPs, except where the BMP falls within a public drainage easement or right-of-way.

## **B. Storm Water Pollution Prevention Plan (SWPPP) – Temporary Controls During Construction**

### **1. Applicable Regulations and Ordinances**

Construction activities shall comply with the SWPPP requirements in Ordinance B-652 (Storm Water Pollution Control Ordinance) and the Environmental Protection Agency (EPA) and Texas Commission on Environmental Quality (TCEQ) regulations. When the ordinance and applicable regulations are in conflict, the most stringent requirements shall apply.

### **2. General Requirements**

Projects that disturb less than 1 acre shall have a SWPPP that complies with the requirements in the Checklist for Small Projects. Projects that disturb 1 acre or more shall comply with the requirements in the Checklist for TCEQ Regulated Construction Projects. These checklists are in Appendices B and C, respectively. Residential projects that disturb less than 12,000 SF and are not part of a larger plan of development are exempt from these requirements.

The SWPPP shall be sealed by an engineer and submitted with the paving and drainage plans for review and acceptance.

### **3. Best Management Practices (BMPs) During Construction**

Structural BMPs shall comply with details and specifications in the latest edition of the NCTCOG BMP Manual titled “*Storm Water Quality Best Management Practices for Construction Activities*” and this manual. When the NCTCOG Manual and this manual are in conflict, this manual shall govern.

The SWPPP shall provide a series of changing BMPs that are appropriate for each phase of construction. The SWPPP shall also identify which

owner/operator is responsible for installing, inspecting and maintaining each BMP during the different phases of construction. All temporary BMPs must be removed after final stabilization is achieved.

The following items are acceptable temporary BMPs for use during construction:

- a. Preservation of existing vegetation - This is a preferred BMP. When areas of existing vegetation are to be preserved, the areas shall be delineated on the plans, and the plans shall include notes stating that temporary chain-link fencing shall be installed to protect the vegetation.
- b. Vegetated buffer strips – Buffer strips may consist of preserved or planted vegetation. The strip shall be at least 10 feet wide, identified on the SWPPP, and flagged or otherwise designated in the field to prevent disturbance. Wider strips shall be specified when the slope is steeper than 10H:1V. If existing vegetation is used, it may be removed at the end of the project for establishment of permanent landscaping. The following design criteria shall be met when using vegetated buffer strips:
  - 1.) The drainage area shall not exceed 0.25 acres per 100 feet length of vegetation.
  - 2.) The maximum distance of flow to the vegetated buffer shall be 100 feet or less.
  - 3.) The up-slope grade perpendicular to the vegetated buffer shall not exceed 5H:1V.
- c. Staked hay bales - This BMP is only acceptable as a perimeter control for sheet flow on the down-slope side of the construction site. The ends of the line of bales shall be turned up-slope, perpendicular to the contours, to form a sediment trap. Bales shall not be placed across swales or other areas of concentrated flow or be placed in front of curb inlets. The following design criteria shall be met when using staked hay bales:
  - 1.) The drainage area shall not exceed 0.25 acres per 100 feet of bale length.
  - 2.) For slopes of 3H:1V and flatter, the maximum distance of flow to the staked hay bales shall be 100 feet or less.
  - 3.) For slopes of 3H:1V and steeper, the maximum distance of flow to the staked hay bales shall be 20 feet.
  - 4.) The up-slope grade perpendicular to the line of bales shall not exceed 1H:1V.
- d. Soil retention blankets – Soil retention blankets shall be anchored per the manufacturer's recommendations. On lots with slopes of 3H:1V or flatter, the blanketed area shall be at least 8 feet wide. Greater widths and additional BMPs shall be specified on steeper slopes. The blankets shall be seeded if used for temporary stabilization before start of home construction. Soil retention blankets used in channels shall meet TxDOT requirements for Type E-H blankets, as appropriate.

- e. Silt fence - Silt fences shall have wire mesh backing and be supported by metal posts. When used as a perimeter control, they shall only be placed down-slope from the construction activity, with the ends turned up-slope, perpendicular to the contours, to form a sediment trap. Silt fences may be used for concentrated flows up to a maximum design flow rate of 0.5 cfs. The following design criteria shall be met when using silt fence:
  - 1.) The drainage area shall not exceed 0.25 acres per 100 feet of fence length.
  - 2.) For slopes between 50H:1V and 3H:1V, the maximum distance of flow to the silt fence shall be 100 feet.
  - 3.) For slopes of 3H:1V and steeper, the maximum distance of flow to the silt fence shall be 20 feet.
  - 4.) The up-slope grade perpendicular to the fence line shall not exceed 1H:1V.
- f. Curb inlet protection – Inlet protection is allowed only as a last resort to site stabilization. Temporary inlet inserts are the only allowable method for inlet protection and are only permitted with specific approval by the DPW.
- g. Temporary inlet inserts – Commercially available or fabricated inserts shall be used when inlet protection is the only viable BMP. Inlet inserts must be configured to pass the inlet’s design flows without causing flooding and are only permitted with specific approval by the DPW.
- h. Temporary detention structure - If 10 acres or more drain to a common drainage point, the SWPPP shall require the low area to be excavated as a temporary detention structure while the drainage facilities are being constructed. This practice is advisable on smaller drainage areas where practicable.
- i. Rock check dams - Rock check dams are appropriate for areas of concentrated flow such as swales and ditches and at the outfall for a subdivision. Rock shall be contained within wire mesh. Check dams shall be placed at a spacing that sets the top elevation of a dam at the toe elevation of the next upstream dam, with the top of the furthest upstream dam set at the invert of the last stabilized portion of the swale or ditch. When check dams are used as an outfall control, the first check dam shall be at least 10 feet from the outfall, but no further than 50 feet from the outfall.
- j. Earthen berms - Earthen berms may be used as a perimeter control to divert runoff from adjacent sites away from the development or to retain runoff within the development. Earthen berms shall be stabilized within 14 days of their construction. The engineer shall analyze the impact of these diversion berms on adjacent sites.
- k. Fibrous mulch – Fibrous mulch may be used as an erosion control to limit the runoff from disturbed areas within the development. Mulch shall be at least 3 inches thick and cover all disturbed areas. When used on slopes of

3H:1V or steeper and in critical areas such as waterways, mulch matting must be anchored with netting to hold it in place.

- l. Hydromulch - Hydromulch stabilization may be used as an alternative to seeding for erosion control when all disturbed area is covered by the hydromulch. A strip of hydromulch is not acceptable unless additional structural controls are provided.
- m. Stabilized construction entrance - All construction entrances shall be stabilized with rock or other non-erodable material. If rock is used, the minimum effective diameter shall be 3 inches. Entrances shall be placed at high points or other areas where runoff from the construction site will not be directed to the entrance. The construction entrance shall not extend into the street or block flow in the gutter.
- n. Other BMPs - It is the responsibility of the engineer to design appropriate BMPs for each site. If the most appropriate BMP is not in the NCTCOG BMP Manual, the engineer shall submit calculations and references for design of the BMP to the DPW.

#### **4. Waste and Hazardous Material Controls**

Covered containers shall be provided for waste construction materials and daily trash. Hazardous materials shall be stored in a manner that prevents contact with rainfall and runoff. Onsite fuel tanks and other containers of motor vehicle fluids shall be placed in a bermed area with a liquid-tight liner or be provided with other secondary containment and spill prevention controls.

The SWPPP shall require federal, state and local reporting of any spills and releases of hazardous materials greater than the regulated Reportable Quantity (RQ) and reporting to the DPW of all spills and releases to the storm drainage system.

#### **5. Temporary Stabilization**

Portions of a site that have been disturbed but where no work will occur for more than 21 days shall be temporarily stabilized as soon as possible, and no later than 14 days after work temporarily ceases.

Temporary stabilization shall consist of providing a protective cover, without large bare areas, that is designed to reduce erosion on disturbed areas. Temporary stabilization may be achieved using the following BMPs: temporary seeding, soil retention blankets, fibrous mulches, hydro-mulches and other techniques that cover 100 percent of the disturbed areas until either final stabilization can be achieved or until further construction activities take place.

Perimeter BMPs such as silt fence, vegetated buffer strips or other similar perimeter controls are intended to act as controls when stabilization has not occurred. Perimeter BMPs may remain in place during temporary stabilization, however, they are not acceptable as final stabilization.

If the site has not been finally stabilized, temporary stabilization measures shall be in place prior to initial acceptance of the public infrastructure.

## **6. Final Stabilization**

Final stabilization consists of soil cover such as vegetation, geotextiles, mulch, rock, chemical modification of the soil, or placement of pavement. For vegetative stabilization, perennial vegetation must cover all disturbed areas without large bare areas and with a density of 70 percent of the native background vegetative cover. Vegetated buffer strips are not allowed unless designed and credited as a permanent BMP. All non-vegetative stabilization must cover 100 percent of the disturbed area.

For stabilizing vegetated drainage ways, sod or seeded soil retention blankets shall be used. Hydromulch will not be allowed in vegetated swales, channels or other drainage ways. BMPs may remain in place during stabilization, however, BMPs shall be removed after stabilization is achieved.

The plan for final stabilization shall be coordinated with the permanent BMPs in the SWMSP and with the landscaping plan, if applicable.

## **7. Notice of Intent (NOI)**

On projects 5 acres in size or larger, the owner and each contractor, including each builder in a residential subdivision, shall submit a copy of the NOI to the DPW at least 2 days prior to construction. When a contractor is acting as the owner's agent and has the ability to direct changes to the plans and specifications, only the contractor needs to submit a copy of the NOI.

## **8. TCEQ Site Notice**

On projects that are 1 acre and larger but smaller than 5 acres, the owner and each contractor shall complete the Construction Site Notice provided in the TCEQ's New General Permit for Construction and submit a copy of it to the DPW at least two days prior to commencement of construction activities. A signed copy of each Construction Site Notice must be posted at the construction site in a location where it is readily viewed by the general public during all construction activity. When a contractor is acting as the owner's agent and has the ability to direct changes to the plans and specifications, only the contractor must submit and post the Construction Site Notice.

## **9. Notice of Termination (NOT)**

All parties that submitted a NOI shall submit a NOT within 30 days after final stabilization is established. When the owner of a residential subdivision transfers ownership of individual lots to builders before final stabilization is achieved, the SWPPP shall include controls for each individual lot in lieu of final stabilization. These controls shall consist of stabilization of the right-of-

way and placement of structural BMPs at the low point of each individual lot or equivalent measures to retain soil on each lot during construction. Additionally, the builder must submit a valid NOI before an NOT can be submitted by the owner.

## **10. Inspection and Maintenance during Construction**

The owner shall construct all BMPs and other controls required by the SWPPP. The owner shall have qualified personnel inspect the BMPs at least every two weeks during construction and within 24 hours after a storm event of 0.5 inches or greater. Alternately, inspections may be performed every 7 days with no additional inspections after rain events. Certified inspection reports shall be retained as part of the SWPPP. Within 7 days of the inspection, BMPs identified as damaged or deteriorated shall be repaired or replaced, as appropriate. BMPs shall also be cleaned to maintain adequate capacity.

If a discharge of soil or other pollutant occurs, the BMPs shall be evaluated. Changes or additions shall be made to the BMPs within 7 days to prevent future discharges. In addition, the owner shall implement procedures to remove discharged soil from all portions of the Municipal Separate Storm Sewer System (MS4) that received the discharge, including streets, gutters, inlets, storm drains, channels, creeks, and ponds.

Notes requiring the inspection and maintenance shall be placed on SWPPP drawings. The SWPPP shall identify the responsible party for inspecting and maintaining each BMP. If no party is identified, each owner and operator that submitted a NOI for the site shall be fully responsible for implementing all requirements of the SWPPP.

Inspectors for the City will not allow construction of public improvements to start, nor will they grant final acceptance of public improvements, until the SWPPP is implemented and maintained.

## SECTION 4.4. WATER AND SANITARY SEWER

### A. Horizontal and Vertical Control

#### 1. Horizontal Control

All plans submitted to the City shall be prepared using the NAD83 State Plane Grid Coordinate System. The City has established horizontal control monumentation that is tied to this coordinate system. Monumentation data is available in the map room or on the City's web page.

#### 2. Vertical Control

Vertical control shall be tied to NGVD 29. The City has established vertical control throughout the City. This information is available in the map room or on the City's web page.

### B. Design Requirements – Water

#### 1. Pipe Sizing

- a. Water mains shall be sized for fully developed conditions based on the current Water and Wastewater Master Plan. In addition, 12-inch water mains shall be installed on a ½ mile grid pattern unless fire flow or domestic services require larger lines. Water lines shall be a minimum of 8 inches throughout the distribution system.
- b. Water lines shall be designed based on 1 gpm for each unit or residence up to 100 and 0.60 gpm for each unit or residence over 100. This criteria shall be used to determine the size of the water lines required to serve a development and eligibility for oversized participation.

#### 2. Line Placement

If street improvements are proposed, the water line placement shall be coordinated with the street plans.

##### a. Vertical

- 1.) The following note shall appear on the water layout plan sheets:

“There shall be a minimum cover of 42 inches over the water pipe as measured from the top of the pipe to the existing ground. Existing ground may be the flow line of the bar ditch, natural ground on the low side of a county-type road, or the proposed finished grade, whichever is lowest.”

- 2.) Water lines along unimproved streets shall have a minimum depth of 5 feet below the lowest ditch elevation to the top of pipe to provide grade for future street improvements.
- 3.) A profile drawing shall also be provided for all water mains 12 inches and larger.
- 4.) When a water main crosses over a sanitary sewer main and the vertical separation is less than nine feet, then the sanitary sewer shall have one joint (20 feet) of PVC pipe conforming to ASTM D-3034, SDR 26 installed centered on the water line. In addition, the joint shall have a minimum of 12 inches of cement stabilized (2:27) backfill directly above the sanitary sewer pipe.
- 5.) When a water main must cross under a sanitary sewer main, the minimum separation shall be 24 inches. In addition, the sanitary sewer shall have installed one joint (20 feet) of ductile iron pipe centered on the water line.

**b. Horizontal**

- 1.) Water lines shall be located 4.5 feet behind the proposed curb. Lines shall be located to clear the back of curb inlets by at least 2 feet by deflecting the pipe or using bends.
- 2.) The minimum radius to be used for PVC water pipe is as follows:

<u>Diameter (Inches)</u>	<u>Minimum Allowable Radius (Feet)</u>
8	200
10	250
12	300

For pipe sizes larger than 12 inches, the minimum radius shall be:  $300 \times D$  (where D = pipe diameter in feet) unless the manufacturer requires a greater radius.

- 3.) When a water line falls between two lots, the water line shall be located entirely within one lot. Water mains adjacent to federal, state, or county roads shall be constructed outside the right-of-way in a separate utility easement.
- 4.) The minimum horizontal separation between any water main and a storm drain facility shall be 2.5 feet or one-half the depth of the water line, whichever is greater.
- 5.) Dead end systems shall be avoided where possible, but if necessary, shall not exceed 2000 feet.

- 6.) The minimum horizontal separation between any water main and a sanitary sewer facility shall be nine feet from the outside edge of pipe to outside edge of pipe.

### **3. Gate Valves**

Gate valves shall be installed at pipe intersections to allow for the isolation of lines for repairs. Valves shall also be placed such that no more than 35 lots will be out of service when a line is out of service. When installed at street intersections, main line valves shall be installed 4.5 feet behind the back of the curb at the point of tangency for the curb return. Valves installed between intersections shall align with common lot lines. Gate valves shall be used on all fire hydrant leads.

The number of gate valves installed shall be one less than the number of leads into the intersection.

### **4. Fire Hydrants**

- a. For all single family detached and duplex residences, excluding townhouses and apartments, fire hydrants shall be spaced to have a fire hose laying distance of no greater than 500 feet. The fire hose laying distance is measured by the laying of fire apparatus hose lines along the right-of-way or access easements from the nearest water supply on a street to the main entrance of the building.
- b. The Fire Marshal may waive the requirement for the lay of hose distance or the installation of a hydrant for subdivisions of 2 lots or less when the existing water supply in the area will not support a hydrant. Appeals to the Fire Marshal's decision shall be made to the Planning and Zoning Commission and City Council. If the development is within 100 feet of an 8" water main, the owner must extend the main to and through the development and provide a fire hydrant.
- c. The minimum fire flow requirements for one- and two-family dwellings having a fire-flow calculation area which does not exceed 3,600 square feet shall be 1,500 gallons per minute. Fire flow and flow duration for dwellings having a fire-flow calculation area in excess of 3,600 square feet shall not be less than that specified in Table B105.1 of the *2003 International Fire Code*.
- d. All fire hydrants must provide a minimum of 35 psi static pressure and a 20 psi residual pressure.
- e. A fire hydrant shall be installed at the end of mains on cul-de-sacs. Other fire hydrants shall be located at street intersections and shall align with common lot lines. Additional fire hydrants may be required between intersections to meet the minimum spacing requirements.

- f. When the street is designated on the Master Thoroughfare Map as an arterial or larger, fire hydrants shall be required on the same side of the street that the building is to be constructed. All streets with medians shall have a fire hydrant on the same side of the street that the building is to be constructed.
- g. Fire hydrants shall be located in accessible protected areas. They shall be located a minimum of 3 feet and no more than 8 feet behind the back of curb. They shall not be located in the sidewalk.
- h. Fire hydrants shall be located outside curb returns and at least 4 feet from a driveway.
- i. A clear space of three feet shall be maintained around all fire hydrants.
- j. Fire hydrant mains shall be placed between 4 feet and 6 feet in depth. Offsets or bends shall be used to bring the fire hydrant up to allowable depths.
- k. Private fire protection systems and private fire hydrant locations shall be approved by the Fire Marshal prior to construction. A fire hydrant shall be installed no more than 150 feet from the fire department connection for an automatic sprinkler system.

#### **5. Automatic Flushing System**

An automatic water distribution flushing system unit shall be placed at the end of all deadend lines in accordance with the standard details.

#### **6. Water Services**

- a. The minimum size water service line shall be 0.75 inches.
- b. The placement of services shall generally be at the lot line using bullhead services where possible.
- c. Services shall not be directly connected to water mains 16 inches in diameter or greater unless approved by the Public Works Director.
- d. Where water meter banks are installed, permanent metal tags with addresses shall be installed on the service line at the curb stop to link the service with the address. The meters shall be installed in a logical sequence.
- e. Water meters and boxes shall be located in accordance with the standard details.
- f. Plans shall contain the stationing of the water service connections.

## **7. Miscellaneous**

- a. Water mains constructed within a subdivision shall be extended to the perimeter of the subdivision to allow for the future extension of the water system into adjacent properties.
- b. All water lines shall be Class 150, AWWA C900, DR18 or other material as approved by the Public Works Director.
- c. All ductile iron fitting shall meet NCTCOG *Standard Specifications for Public Works Construction* and shall be of domestic manufacture.
- d. When the water facilities fall under the jurisdiction of a provider other than the City, the facilities shall meet or exceed all requirements contained herein. A water analysis must be provided with the development of more than 4 residential lots with the zoning case or preliminary plat. The water analysis must be performed during a peak usage time between 5:00 and 7:00 p.m.

A copy of the plans shall be provided to the City for its records. Prior to construction, a letter must be provided to the City from the service provider stating that they have reviewed and accepted the plans for construction. The City reserves the right to verify water pressures and volumes upon installation. The owner shall bear any cost the City incurs for verification.

For subdivisions containing four (4) lots or fewer, a letter from the water service provider is required stating there are adequate facilities in the area to provide domestic service and fire protection. When the City has reason to believe that there may be water supply or pressure concerns, a water system analysis may be required.

## **C. Design Requirements – Sanitary Sewer**

### **1. Pipe Sizing**

- a. Sanitary sewer mains shall be adequately sized to serve the development and upstream drainage basin. Design must also be based on the current Water and Wastewater Master Plan. Sanitary sewer mains shall be extended through the development to serve abutting property as required. Sanitary sewer mains shall be a minimum of 8 inches in diameter.
- b. Sanitary sewer systems shall be designed based on an average flow of 100 gallons per person per day without separate provisions for infiltration. The population density shall be based on three persons per single family unit, but shall not be less than 9.5 persons per acre.

- c. For outfall and collector sewers, or when the drainage area is larger than 100 acres and the proposed land use (zoning) is unknown, Harmon's Formula shall be used to determine peak dry weather flow.

Harmon's Formula:

M = Ratio of design load to average load

$$M = 1 + \frac{14}{4 + \sqrt{P}}$$

P = Population in thousands, assuming a density of 14 people per acre

Sewer Line sizing procedure is as follows:

$$L = \text{Load / Person / Day} = 100 \text{ gal/person/day}$$

$$A = \text{Average load / person} = L/1440 = 0.694 \text{ gal/min/person}$$

T = Total average load of a given population

$$T = A \times \text{ultimate population within sewer basin}$$

$$D = \text{Design Load} = M \times T = \text{gal/min (gpm)}$$

In certain areas, the design load (D) may need to be increased by an infiltration factor to be provided by the City.

- d. In addition, infiltration shall be estimated at 100 gpd per acre of drainage basin and shall be added to the peak dry weather flow to determine the total peak flow. The peak flow shall be 75 percent of the pipe capacity. Capacities shall be calculated using a Manning's (n) equal to 0.013. The engineer may be required to submit design calculations to the DPW for review.
- e. Other methods may be used with DPW approval. Line sizing is subject to the final approval of the Public Works Director.
- f. A minimum velocity of 2 fps shall be maintained. Associated slopes are listed below:

<u>Diameter (inches)</u>	<u>Slope (ft/ft)</u> <u>n = 0.013</u>
8	0.0040
10	0.0028
12	0.0022
15	0.0015
18	0.0012
21	0.0010
24	0.0008
27	0.00067
30	0.00058
36	0.00046

## 2. Line Placement

If street improvements are proposed, the sanitary sewer line placement shall be coordinated with the street plans.

### a. Vertical

- 1.) Sewer mains shall be installed on a uniform grade between manholes. Particular care shall be taken to avoid rapid grade changes or reduced velocities at the lower section of the sewer main.
- 2.) Sanitary sewer lines constructed along unimproved streets shall be a minimum of 8 feet below the level of the lowest part of the existing street or bar ditch to provide grade for future street improvements.
- 3.) Sanitary sewer mains and services shall be encased in Class 'A' concrete where:
  - the cover is 3 feet or less in paved areas, measured from the top of subgrade
  - the cover is 2 feet or less in parkways
  - the line has 2 feet or less of clearance beneath proposed storm drains or conduits.
- 4.) A profile drawing shall be provided for all sanitary sewer mains.
- 5.) Vertical curves in the sanitary sewer main will not be allowed.

### b. Horizontal

- 1.) The minimum radius for PVC sewer pipe shall be determined using the following formula:

$$R = 300 \times D$$

R = minimum allowable radius of curvature

D = pipe diameter

R & D are in the same dimensional units

For pipe sizes greater than 12" only tangent sections will be permitted.

- 2.) Sanitary sewer lines shall be placed at the quarter-point of the street opposite the drainage pipe.
- 3.) When a sewer line falls between two lots, the sewer line shall be located entirely within one lot. Sewer mains adjacent to federal, state,

or county roads shall be constructed outside the right-of-way in a separate utility easement.

- 4.) The minimum horizontal separation between any sewer main and a storm drain facility shall be 2.5 feet or one-half the depth of the water line, whichever is greater.
- 5.) The minimum horizontal separation between any water main and a sanitary sewer facility shall be nine feet from the outside edge of pipe to outside edge of pipe.

### **3. Manholes and Cleanouts**

- a. Manholes shall be required at a maximum spacing of 500 feet on public sewer lines. Manholes are required at direction, pipe size, and grade changes.
- b. A standard manhole is 60 inches in diameter for pipe sizes up to 24 inches. Manholes installed on pipe 24 inches or larger will require a 72" diameter manhole. Special circumstances such as acute angles, numerous connections or pipe diameters exceeding 36 inches may require modifications in size requirements which will be reflected in the design plans.
- c. Drop manholes shall only be used for depths greater than 12 feet or where the difference in the flowline is greater than 18 inches. Internal drops shall be used.
- d. A manhole shall be installed at the end of mains on cul-de-sacs. A maximum of three sanitary sewer services may be installed to the manhole at the end of a cul-de-sac.
- e. Sewer service connections shall discharge into the manhole at the top of the bench.
- f. Where manholes are located within the 100-year floodplain, watertight rings and lids shall be used. Vents shall be provided in accordance with TCEQ requirements.
- g. The top of manholes shall be set at 1 foot below the top of the subgrade when located in future pavement and raised to grade with the pavement construction or 6 inches above existing natural ground outside paved areas.
- h. When tying to existing manholes, the invert must be reworked.
- i. Cleanouts shall not be permitted unless the line will be extended with a future phase of the development.

#### **4. Sanitary Sewer Services**

- a. Generally, sanitary sewer services are a minimum of 4-inches in diameter and shall be installed below water services and shall be located 9 feet downstream of the center line of the lot. Exceptions will be considered on an individual basis. Services greater than 4 inches in diameter are required to connect to a manhole installed on the main.
- b. All services shall be a maximum of 10 feet deep unless otherwise approved by the DPW. If the existing or proposed sewer main is deeper than 15 feet, a parallel sewer shall be constructed that is less than 15 feet deep. When the sewer service is between 10 feet and 15 feet deep, the deep sewer service detail shall be used.
- c. Where lot grades are lower than the street, located in the floodplain, or a storm drain crosses the sanitary sewer main, the flow line elevation of the sewer service line at the property line shall be provided.
- d. The plans shall show the stationing of the sanitary sewer service connections.

#### **5. Lift Stations and Separate Treatment Facilities**

Lift stations or separate treatment facilities will not be permitted unless, in the opinion of the Public Works Director, there is no feasible alternative that can provide the necessary service to the proposed subdivision.

#### **6. On-site Sewer Facilities**

Sub-urban and rural subdivisions may be approved with alternative sewer facilities according to the following criteria:

- a. An on-site sewage facility may be installed to service an individual residence if:
  - 1.) the premise upon which the structure is located is more than 1000 feet from an approved sanitary sewer main.
  - 2.) the location of an alternative sewage facility is not within a designated floodplain.
  - 3.) The DPW agrees in writing that the topography of the site makes normal connection with the existing sanitary sewer main impractical or impossible.
  - 4.) The operation of an alternative sewage facility is feasible on the site and will meet the standards and requirements of the Texas Commission on Environmental Quality rules for on-site sewage facilities, except that the minimum size lot for which an alternative sewage facility can be installed is one acre.

- b. If an alternative sewage facility is approved for use, it shall be installed on a lot or building site that contains a minimum of one acre or be of such greater area as determined by the City. All alternative sewage facility system installation shall comply with Chapter 34 of the Burleson Code of Ordinances.
- c. Under normal circumstances, alternative sewage facilities will not be accepted as appropriate sewer facilities for the subdivision of land within the City.
- d. Within rural subdivisions, other alternative sewage facilities can be considered if satisfactory evidence is submitted certifying that the system meets all requirements of standards of the Texas Commission on Environmental Quality (except lot size), all applicable City ordinances, and the provisions of this manual.
- e. The following shall be provided prior to approval of any plat of the property:
  - 1.) Soil analysis, groundwater evaluation, surface drainage analysis, and separation requirements as required by the Texas Commission on Environmental Quality.
  - 2.) A statement from a licensed engineer or registered sanitarian that the site is suitable for on-site sanitary sewer systems.
- f. Easements for the future construction of sanitary sewer lines to serve the subdivision shall be provided on the plat or by separate instrument.
- g. Whenever the City sanitary sewer is extended to within 200 feet of any lot or tract within the City where an on-site sanitary sewer facility exists, the owner or occupant of each tract or lot shall abate the on-site sanitary sewer facility and shall construct a suitable water closet and connect with an approved sanitary sewer main within 30 days after written notice is provided from the City. In the event the property is required to tie onto a system not belonging to the City, and the system owner denies access to the system, the property owner is relieved of the obligation, until such time as access to the system is possible. Proof of denial of access to the sanitary system shall be through a sworn affidavit from the system owner.

## **7. Miscellaneous**

- a. Sanitary sewer pipe shall be SDR-35 for depths less than 12 feet and SDR-26 for depths greater than 12 feet.
- b. At sanitary sewer junctions within a manhole, the crown of each pipe shall be matched. Where a larger upstream line connects to a smaller downstream line, the flow lines shall be matched.
- c. Aerial crossings of open drainage features shall incorporate the use of trusses, wide flange beams, or the strapping of the line to bridge structures

or culverts to minimize the number of piers within the open drainage feature. Spread footings shall not be used in pier design.

- d. Ductile iron pipe shall generally be used for aerial crossings, trench spans, fill areas, bored and grouted pavement crossings, or where cover is minimal.
- e. Sewer mains constructed within a subdivision shall be extended to the perimeter of the subdivision to allow for the future extension of the sewer system into adjacent properties.
- f. No connection shall be made to any sanitary sewer within the City that will permit the entrance of surface water or waste that has other than domestic characteristics without the authorization of the City Council.
- g. When the sanitary sewer facilities installed fall under the jurisdiction of a provider other than the City, the facilities shall meet or exceed all requirements contained herein. A copy of the plans shall be provided to the City for its records. Prior to construction, a letter must be provided to the City from the service provider stating that they have reviewed and accepted the plans for construction.
- h. All 12-inch and smaller sanitary sewer mains using poly-wrapped ductile iron pipe shall be Class 350 or greater. A greater pipe class may be required to accommodate trench conditions.

#### **D. Utility Easements (Water & Sanitary Sewer)**

Utility easements are required for all public water and sanitary sewer lines installed outside of the street right-of-way. Generally, utility easements shall be a minimum of 15 feet wide except when a utility easement is adjacent to another easement or right-of-way. In this case, 10 feet is allowed. When both water and sanitary sewer lines are located in the same easement or other facilities are within the easement, the minimum width shall be 20 feet. Where water or sanitary sewer lines are constructed deeper than 10 feet, the easement width shall be a minimum of 20 feet. For deep lines, the width of the easement shall encompass the trench width and side slopes which are based on one horizontal to one vertical for each side of the trench unless otherwise approved by the DPW.

When a utility easement falls between two lots, the easement shall be contained within one lot. Mains adjacent to federal, state, or county roads shall be constructed outside the right-of-way in a separate utility easement.

When utility easements are not dedicated by plat, the owner shall submit the ownership information, metes and bounds description, and the exhibit of the utility easement to the DPW. The description and easement shall be sealed, signed, and dated by a registered public land surveyor.

The filing process for separate easements can be found in Chapter 3 of this manual.

## SECTION 4.5 STREETS

### A. Master Thoroughfare Plan

Included in Appendix D is a map illustrating the Master Thoroughfare Plan (MTP). All developments shall comply with the MTP. Contact the DPW for the latest amendments to the MTP.

### B. Street Lighting Standards

Streetlights shall be designed and installed in accordance with the following criteria:

1. All lights will be 100 watt HPS.
2. Lights will be placed at all street intersections except at major thoroughfares where median lighting is existing.
3. Lights will be spaced a maximum of 600 feet along local and collector streets. Lights will be spaced a maximum of 200 feet along arterial streets.
4. Lights will be placed no closer than 500 feet except for intersections, in cul de sacs, and where curves or grades require additional lighting.
5. All cul de sacs longer than 200 feet from centerline of street to center point of cul de sac shall have a light at the street intersection and at the end of the cul de sac.
6. All severe curves or areas with poor sight visibility shall be lighted.
7. Lights shall be placed so as to gain the maximum use of existing and proposed physical characteristics.
8. Electric service to the streetlight shall be underground.
9. Streetlights shall not be constructed in conflict with the sidewalk.
10. Decorative lights may be approved on a case by case basis.

### C. Gated Entry

All gated entries must include turnaround facilities to accommodate a type "SU" vehicle and provide ingress for a fire truck. Placement of gate location and call box may vary based on trip generation for the development. All gated entries must be equipped with a Knox System Gate Access Key Switch.

Gated entries for apartment complexes must remain open during the hours of 7 to 9 a.m. and 4 to 6 p.m.

Any variation from the typical gated entries included in this section will require approval of the DPW. Refer to Appendix E for gated entry layout designs.

Public streets shall not be gated.

#### **D. Intersection Geometric Design**

Typical layouts of various street intersections are included in Appendix F.

#### **E. Sight Distance Criteria**

At controlled or uncontrolled intersections of any public street, the minimum intersection sight distance (visibility triangles) shall have the dimensions as illustrated in Figure 1 in Appendix G. Where a driveway intersects a public street, the minimum intersection sight distance shall have the dimensions as illustrated in Figure 2 in Appendix G. Additional sight distance may be required based on topography, roadway curvature, vegetation or other sight hindrance.

Deviations from the minimum intersection sight distance requirements may be allowed provided that the owner has demonstrated that the area proposed will provide adequate sight distance based on AASHTO standards. All deviations must be approved by the DPW.

The City may require a visibility study for street and driveway connections in curves.

#### **F. Residential Driveway Design Criteria**

##### **1. Design Standards**

The values in Table are standards to be used for the design and construction of driveways:

**TABLE 1  
Driveway Design Criteria**

<u>Requirements</u>	<u>Street Class</u>	<u>Residential Driveway</u>
Driveway Throat Width <sup>6</sup>	Local	10-28 feet
	Minor Collector	10-28 feet
	Major Collector	12-28 feet
	Arterial	12-28 feet
Driveway Curb Radius	Local	2.5-10 feet
	Minor Collector	2.5-10 feet
	Major Collector	10-20 feet
	Arterial	15-30 feet
Minimum Driveway Centerline Spacing	Local	15 feet
	Minor Collector	15 feet
	Major Collector <sup>1</sup>	100 feet
	Arterial <sup>1</sup>	100 feet
Driveway Angle		70-90 degrees
Minimum Distance <sup>2</sup> from Driveway to Intersection	Local	30 feet
	Minor Collector	50 feet
	Major Collector	240 feet
	Arterial	250 feet
Max Approach Grade <sup>3</sup>	Local/Minor Collector	+9%
	All Others	+6%
Min Approach Length <sup>4,5</sup>	Local/Minor Collector	6 feet
	All Others	9 feet

**Notes:**

<sup>1</sup> Head out egress shall be provided. Driveways for single-family infill lots that cannot meet this criteria will be approved on a case by case basis.

<sup>2</sup> Distance measured from the intersection of the extended right-of-way lines to the centerline of the driveway. In no case shall the driveway centerline be closer than 100 feet to the curb return departure of the major street facility.

<sup>3</sup> The percent slope measured along the centerline of the driveway.

<sup>4</sup> The minimum distance over which the maximum approach grade must be maintained.

<sup>5</sup> The approach grade and length shall be altered to include a sidewalk section through the drive approach as applicable. See typical details for drive approaches.

<sup>6</sup> The maximum driveway width may be increased to 32' if serving a three-car garage.

## **2. General Design Criteria**

Driveway access to a residential lot from any major collector or arterial shall not be permitted unless that lot has no other public access or meets the requirements of the Subdivision Ordinance and this manual. The Public Works Director may require shared access easements.

A residential driveway shared by two or more properties shall have a minimum throat width of 12 feet. A joint-use private access easement shall be required. Shared residential driveways may be required for adjoining residential lots on major street facilities (arterials, minor collectors and collectors) to reduce the number of access points on those roadways.

To provide adequate vehicle storage and maneuvering area, a setback of 25 feet (minimum) shall be required between the street right-of-way and all garages or other structures served by the driveway. For side-yard driveways to local streets, a setback of 20 feet will be allowed. A maneuvering space of 24 feet (minimum) shall be required for all rear-entry garages that may extend into an adjacent access easement or alley.

A circular residential driveway may be allowed on any street type provided that the centerlines of the driveways are at least 50 feet apart and the other requirements in Table I are met. A circular residential driveway accessing two streets shall only be permitted for 31 feet wide residential streets.

If such a driveway is approved on a major street facility, an off-street maneuvering area shall be provided to ensure that vehicles will not back into the public street. Driveway access to a residential lot from a minor collector street may be denied if the lot has access to a local street or the proposed access would create a traffic flow or safety problem.

Driveway connections to rural road sections across bar ditches shall be installed in accordance with the City's standard detail. The culvert shall be sized by the owner's engineer. The minimum culvert size is 18" and shall be RCO. The maximum slope from the edge of driveway to the top of culvert pipe shall be 6:1 and the end of the pipe shall contain sloped end treatment. During the driveway installation, all ditch grading upstream and downstream of the proposed driveway culvert is the responsibility of the property owner.

## **3. Maintenance**

Maintenance of the driveway approach shall be the responsibility of the owner.

## **G. Right-of-Way**

Right-of-way shall be in accordance with the Master Thoroughfare Plan, the Subdivision and Development Ordinance and Zoning Ordinance.

## H. Horizontal and Vertical Control

### 1. Horizontal Control

All plans submitted to the City shall be prepared using the NAD83 State Plane Grid Coordinate System. The City has established horizontal control monumentation that is tied to this coordinate system. Monumentation data is available in the map room or on the City's web page.

### 2. Vertical Control

Vertical control shall be tied to NGVD 29. The City has established vertical control throughout the City. This information is available in the map room or on the City's web page.

## I. Street Design Requirements

### 1. Design Speed

All streets shall be designed and constructed to provide the following design speeds:

<u>Street Type</u>	<u>Design Speed</u>
Arterial	50 miles per hour
Major Collector	45 miles per hour
Minor Collector	35 miles per hour
Local Street	35 miles per hour

### 2. Minimum Radius

The required radius for curb returns at intersections shall be as follows:

Arterial/Arterial	80 feet*
Arterial/Major Collector (departure side)	80 feet*
Major Collector/Major Collector	30 feet
Arterial/All Others	35 feet
Major Collector/All Others	30 feet
Local Streets	20 feet
Alleys/All Others	30 feet

\*The minimum allowable radius is 35 feet and 30 feet, respectively. See the Intersection Geometric Design in Appendix F.

The minimum radius for the back of curb on a cul-de-sac shall be 40 feet.

### 3. Vertical Alignment

- a. All streets shall be designed and constructed to a minimum grade of 0.5%; unless the required geotechnical report indicates the soil has a PI greater than or equal to 40, a minimum grade of 1% shall be required.

All streets shall have a maximum grade as follows:

<u>Street Type</u>	<u>Maximum Grade</u>
Arterial	6.0%
Major Collector	8.0%
Minor Collector	8.0%
Local	10.0%

- b. In order to maintain adequate sight distance, all streets shall be designed and constructed to comply with the following minimum vertical curve length for each algebraic percent difference in grade. Grade changes where the algebraic percent difference is less than one percent are not required to use vertical curves.

<u>Street Type</u>	<u>Crest Curves</u>	<u>Sag Curves</u>
Arterial	120	90
Major Collector	80	70
Minor Collector	50	50
Local	30	40

- c. The following maximum intersection grades involving arterial and major collector roadways shall be used at controlled intersections.

<u>Design Street Type</u>	<u>Intersecting With</u>	<u>Design Street Maximum Grade</u>	<u>Distance</u>
Arterial	Arterial	2%	300 feet
Arterial	Major Collector	3%	300 feet
Major Collector	Arterial	3%	200 feet
Major Collector	Major Collector	3%	200 feet
Minor Collector/Local	Arterial/ Collector	4%	150 feet

#### 4. Horizontal Alignment

- a. The following minimum centerline radii shall be used in the design of all street construction:

<u>Type Street</u>	<u>Minimum Centerline Radius</u>
Arterial	1000 feet
Major Collector	800 feet
Minor Collector	500 feet
Local	As approved by the DPW
Cul-de-sacs and Loop Streets	50 feet radius to right-of-way line

- b. Reverse curves shall be separated by a tangent section in accordance with the following table:

<u>Type Street</u>	<u>Minimum Centerline Radius</u>
Arterial	200 feet
Major Collector	100 feet
Minor Collector	50 feet
Local	As approved by the DPW

- c. Major collector or arterial roadways intersecting other major collector/arterial roadways shall have the following minimum horizontal centerline approach tangent section length as measured from the nearest right-of-way line of the intersecting street, unless such requirement is waived by the DPW:

<u>Type Street</u>	<u>Intersecting With</u>	<u>Minimum Approach Tangent</u>
Arterial	Arterial	200 feet
Major Collector	Arterial	150 feet
Major Collector	Major Collector	100 feet

- d. More than two streets intersecting at a point shall be avoided. No street intersecting an arterial street should vary from a 90 degree angle of intersection by more than 5 degrees. Streets intersecting collector streets should not vary from a 90 degree angle of intersection by more than 10 degrees. All other street intersections should not vary from 90 degrees angle of intersection by more than 15 degrees.
- e. The curvilinear requirements described in Article 5 of the Subdivision and Development Ordinance must be accommodated.
- f. All streets should be designed to be in line with existing streets. When conditions require the centerlines to be offset, a minimum of 135 feet offset distance is required. Greater centerline offsets may be required when necessary for traffic safety.

## 5. Paving Requirements

Both public and private streets shall be designed in accordance with the requirements outlined below.

- a. Standard pavement widths and sections shall be constructed on prepared subgrade in accordance with the City of Burleson Standard Details and Specifications. Pavement widths shall be measured from back of curb except for local rural roadways where the width is measured from edge of pavement. The street classification shall be as shown in the Thoroughfare Plan Map. The widths and thicknesses shall be in accordance with the information provided on the typical section details and the following table.

Street Classification	Width	Thickness Concrete	Thickness HMAc
Local Rural or Sub-urban (L2U)	30 feet <sup>(1)</sup>	6 inches	7 inches
Local (L2U)	31 feet	6 inches	7 inches
Minor Collector (C3U)	41 feet	6 inches	7 inches
Major Collector (C4U)	49 feet	7 inches	N/A
Minor Arterial (P5U)	68 feet	8 inches	N/A
Minor Arterial (P4D)	2 x 25 feet	8 inches	N/A
Principal Arterial (P6D)	2 x 37 feet	8 inches	N/A
Private Access Easement / Alley/Fire Lane	20 feet <sup>(2)</sup>	6 inches	N/A

<sup>(1)</sup> A 12" wide x 18" deep reinforced concrete containment strip shall be constructed along both edges of the pavement.

<sup>(2)</sup> The pavement width of a private access easement shall be increased to 24 feet when it functions as a required fire lane.

- b. All concrete shall be reinforced with #4 bars on 24-inch centers.
- c. All streets shall be constructed with a lime stabilized or cement stabilized subgrade. In order to determine the appropriate stabilization and application rate, the owner shall provide a geotechnical report prepared by an engineer. The application rate shall be specified in the plans. The minimum application rate shall be 30 lbs. per square yard at 8" depth.
- d. In small areas, such as the addition of median openings or auxiliary lanes to existing facilities, lime and cement stabilization can be difficult. In these areas 6-inch flexible base (TxDOT Type A, Grade 1) or 4-inch additional pavement thickness on compacted base may be used.
- e. Pavement widths may be modified for a Planned Development Community with the approval of the Public Works Director, the Director of Community and Economic Development, and the Fire Marshal.

- f. Where rural roadway sections are constructed, the maximum front slope is 6:1 and the maximum back slope is 3:1.

## **6. Median Openings**

Requests for median openings for private or public developments shall be submitted to the DPW for approval. The following shall be submitted with the request:

- A drawing showing the location and distance to the next median opening. The drawing shall also include any driveways, public streets and property lines within 600 feet of the requested opening.
- A letter from property owners on both sides of the street within 600 feet stating their concurrence of the proposed location of the median opening.

Generally, median openings shall be spaced 600 feet apart (measured nose to nose) on principal arterials and 450 feet (600 feet from major intersections) on minor arterials. Median opening noses are typically 12-15 feet beyond the projection of the curb or driveway edge of the facility being served. Median openings may require the construction of left turn lanes. The typical storage length is 150 feet with 150 feet transition. The storage length may be altered based on projected traffic volumes.

If approved, all costs associated with the median opening shall be paid by the owner. The median opening shall be constructed or funds escrowed within 6 months of the date of approval, or the request shall be void.

### **a. Existing Improved Streets**

The owner shall submit construction plans to the DPW for review. Upon acceptance of the plans, a Community Facilities Contract will be required for construction of the opening. All costs associated with the median opening shall be paid by the owner including construction and relocation of utilities and irrigation that may conflict with opening. If the remainder of the median is less than 8 feet wide it must be constructed in accordance with City standard median details. The request for a median opening shall be void if the median opening has not been constructed within 6 months of the date of approval.

### **b. Unimproved Streets - Construction Plans Available**

Owner shall hire an engineer to modify the existing plans to include the median opening and prepare a construction cost estimate. The plans shall be in accordance with the standard details. The owner shall escrow the construction cost of the median opening with the City. The cost shall be escrowed within 6 months or the request shall be void.

**c. Proposed Street – No Construction Plans Available**

No median opening requests will be considered until an engineering services contract is initiated for the design of the street.

**7. Deceleration Lanes**

Deceleration lanes shall be constructed in accordance with requirements contained within the Traffic Study.

**8. Screening of Double-Frontage Lots**

Where residential development backs up to an arterial street, masonry screening shall be provided along the rear lot lines. Natural tree or other acceptable plant cover shall be provided in addition to the masonry screening wall.

**9. Sidewalks, Walkways, and Access Ramps**

Sidewalks and access ramps must be constructed in accordance with State and Federal regulations. The owner is responsible for submitting all pertinent information with regard to sidewalks and access ramps to the Texas Department of Licensing and Regulation (TDLR) prior to construction as required. The following describes general requirements for sidewalk and access ramp construction:

- a. Sidewalks shall be shown on the subdivision construction drawings. Generally, they shall be constructed by the homebuilder except where the sidewalks do not abut a residential lot or when the residential lot backs up to an existing street. In these cases, the sidewalks shall be constructed with the subdivision public paving improvements. The construction drawings shall clearly identify which sidewalks are to be constructed with the public paving improvements.
- b. Sidewalks shall be placed on both sides of the street within the right-of-way, shall be 4 feet wide and placed 1 foot off the right-of-way line. If necessary, sidewalks may be placed closer to the curb, but no closer than two feet except where site restrictions require the sidewalk to be placed closer to the curb. In these cases, the sidewalk shall be adjacent to the curb and shall be six feet in width. Sidewalks adjacent to the back of curb will generally not be allowed within residential areas due to common obstructions such as mailboxes, streetlights and fire hydrants.
- c. Sidewalks within a connectivity route must be 6' in width. The back edge of connectivity sidewalks must be located one foot behind the right-of-way line. A sidewalk easement must be dedicated behind the right-of-way line to contain the sidewalk.
- d. Sidewalks designated as park trails shall be a minimum of 8' in width.

- e. If obstructions are within the path of a proposed sidewalk, the sidewalk width and placement may be adjusted to allow the obstruction to remain. In these cases, a minimum sidewalk width of three feet shall be maintained. Obstructions in sidewalks will not be permitted.
- f. Access ramps shall be designed and constructed at all street intersections concurrent with the street construction. Mid-block ramps are required for local streets and at signalized locations.
- g. Sidewalks are not required for local rural standards.
- h. The developer may request in writing a determination by the Public Works Director that construction is either not feasible at the time of development for engineering reasons or inappropriate due to the nature of the construction project.

#### **J. Private Facilities**

Private street improvements shall be designed in accordance with City standards and shall meet the minimum construction standards for public streets. Inspections of private facilities shall be performed by the City at the owner's expense at the fee set by the City Council.

Prior to initial acceptance of private street improvements, an as-built letter or as-built plans sealed, signed, and dated by the design engineer shall be submitted certifying that the facilities were constructed in accordance with the accepted plans.

## SECTION 4.6 DRAINAGE

When a development requires the construction of drainage facilities, the following drainage plan requirements shall be used.

### A. Peak Runoff

The City may have flow rates available for watersheds with a drainage area greater than 1,000 acres. If so, these shall be used in the drainage calculations. Where no flow rates are available, unit hydrograph techniques shall be used.

The Rational Method ( $Q=CIA$ ) shall be used for calculating peak runoff from watersheds of 200 acres or less.

#### 1. Runoff Coefficients

Storm water runoff shall be based on a fully developed watershed. The most intense land use or zoning shall be used to determine the runoff coefficient for the fully developed watershed. The following table gives values for runoff coefficients that shall be used in the determination of storm water runoff.

RUNOFF COEFFICIENT "C"				
Zoning or Land Use	Hydrologic Soil Groups			
	A	B	C	D
Parks and Permanent Open Space	.35	.37	.39	.41
SFE Zoning	.43	.45	.47	.50
SF7, SF7D, SF10, and SF16 Zoning	.50	.52	.55	.58
2F Zoning	.60	.63	.66	.70
MH and MHP Zoning	.65	.68	.72	.76
MF and SFA Zoning	.65	.71	.87	.90
NS, GR, C, Zoning and Schools & Churches	.95	.96	.98	1.00
CC, OT, and I Zoning	1.00	1.00	1.00	1.00

#### SOIL GROUP CLASSIFICATION

- Group A Deep sand, aggregated silts
- Group B Sandy loam
- Group C Clay loam, shallow sandy loam
- Group D Heavy plastic clays

#### 2. Intensity

TP-40 shall be used to determine the rainfall intensity. Refer to Appendix H.

#### 3. Time of Concentration

The time of concentration shall be based on fully developed conditions for the upstream watershed. The total time of concentration shall include overland and channelized flow. The maximum length allowed for the overland portion of the calculation is 50 feet. The remainder of the watershed shall be considered channelized flow. Refer to Appendix I to determine the velocity, which is used to calculate the time of concentration. The minimum time of concentration shall be 10 minutes.

#### 4. Storm Frequency

The following table shows the minimum design frequency to be used when designing drainage facilities:

<u>Type Of Facility</u>	<u>Minimum Design Frequency</u>
On-grade inlets	5 years
Low point inlets	100 years
Storm sewers upstream of low points	5 years
Storm sewers downstream of low points	100 years
Street right-of-way	100 years*
Channels and creeks	100 years
Creek culverts and bridges	100 years
Permanent bar ditch and associated culverts	5 years

\*Depending on the amount of flow in the right-of-way, additional drainage infrastructure may be required to reduce the flow in order to protect the health, safety and welfare of the general public.

#### 5. Drainage Areas

The drainage area shall be based on fully developed areas within and contributing to the development, shall follow natural drainage features, and shall not be diverted. Existing or anticipated features modified by the development shall be considered when outlining drainage areas. A drainage area map shall be prepared identifying the contributing drainage areas.

When sizing drainage systems, upstream detention shall not be considered.

## B. Roughness Coefficients and Permissible Velocities

The following table provides roughness coefficients and permissible velocities:

Type of Section/Feature	Coefficient of Roughness "n"	Velocity, fps <sup>1</sup>
I. Natural Creeks		
A. Creek Section		
1. Some grass and weeds; little or no brush	0.045	3.0 to 8.0
2. Dense growth of grass or brush	0.055	3.0 to 8.0
3. Dense brush and trees	0.065	3.0 to 8.0
B. Floodplain/Overbank Areas		
1. Grass, Weeds, Some Brush and Trees	0.045	3.0 to 8.0
2. Dense Grass, Weeds or Brush	0.055	3.0 to 8.0
3. Dense Brush and Trees	0.080	3.0 to 8.0
II. Improved Open Channels		
A. Gabion Channels	0.035	3.0 to 10.0
B. Pre-Cast Concrete Block Channels	0.035	3.0 to 10.0
C. Natural Stone Channels	0.035	3.0 to 10.0
D. Grass Vegetated Channels	0.045	3.0 to 8.0
E. Concrete Channels	0.016	5.0 to 15.0
F. Rock Rip-Rap Channels	0.035	5.0 to 10.0
III. Streets		
A. Concrete	0.015	N/A
B. Asphalt	0.015	N/A
VI. Pipe		
A. Reinforced Concrete Pipe	0.013	3.0 to 15.0
B. Corrugated Metal Pipe	0.022	3.0 to 15.0
C. High Density Polyethylene Pipe	0.011	3.0 to 15.0

<sup>1</sup> Froude number should not be between 0.86 and 1.13.

## C. Street Capacity Design

### 1. Streets with Curb and Gutter

Local and minor collector streets shall be designed to flow less than curb deep during a 5-year storm. For major collectors and arterials, one lane in each direction shall remain dry during the design storm. On all streets, the runoff from the 100-year storm shall be contained within the street right-of-way and shall not exceed 0.2 feet above the lowest top of curb.

## **2. Local Rural Streets**

Local rural streets shall be constructed with bar ditches in lieu of curb and gutter. The 100-year storm shall be contained within the right-of-way and the flow shall not exceed the street crown elevation. Transitional materials may be required at driveway culverts to prevent erosion. Culverts under driveways shall be reinforced concrete pipe and a minimum of 18 inches and designed to carry the 5 year storm. The driveway or roadway shall also have an invert above the pipe for positive overflow. If a culvert is not feasible, the driveway shall be constructed with an invert.

### **D. Closed System Design**

Closed systems shall be used when the flow can be carried in a 60-inch diameter pipe or smaller, unless otherwise approved by the Director. The closed system shall be connected to an existing system or extended until it reaches an open channel or natural creek.

#### **1. Drainage Easements**

A drainage easement shall be dedicated for all closed systems, unless the closed system is located on the most upstream lot. The minimum width of a drainage easement is 15 feet. When combined with other utilities, the minimum width is 20 feet. The easement may need to be larger to accommodate systems with pipe sizes larger than 60 inches or deep systems.

When a drainage easement falls between two lots the easement shall be contained within one lot.

#### **2. Placement within Street.**

Drainage pipe shall be placed at the quarter-point of the street opposite the sanitary sewer.

#### **3. Hydraulic Grade Line (HGL)**

The hydraulic grade line (HGL) for the design storm shall be shown on the plans and shall be below the bottom of the subgrade for systems under pavement. For systems outside of the pavement, the HGL shall be lower than all inlet throats and shall not exceed one pipe size above the top of pipe. The HGL shall start at the inside top of pipe or at the HGL of a connecting feature, whichever is higher.

#### **4. Head Losses**

The design techniques and methods used in the determination of all head losses shall be approved by the DPW. The City of Fort Worth's *Storm Water Management Design Manual* or TxDOT's *Hydraulic Design Manual* are acceptable guides for calculating head losses.

## **5. Entrance/Outfall Structures**

Headwalls or sloped end treatments shall be constructed at the pipe ends of all storm sewer systems. Sloped end treatments are required along streets when the drainage feature is adjacent and parallel to traffic flow. The sloped end treatment shall be a 6H:1V end section. Storm sewer systems that outfall to a creek shall be extended to the flowline (toe of slope) of the creek. Gabion mattresses shall be installed at the outfall structure to lower velocities and prevent erosion.

## **6. Pipe**

Underground systems shall be constructed, as a minimum, with Class III reinforced concrete pipe. The pipe size shall be a minimum of 18 inches. A higher class of pipe may be required when constructed shallow or deep. The City may allow plastic pipe for certain applications; however, plastic pipe is never allowed under street paving.

Minimum distance from top of curb to top of pipe is typically three feet.

All pipe bends and fittings shall be prefabricated. Collar connections shall be in accordance with the City standards. Pipes shall not be designed with vertical curves.

Radius pipe is allowed and shall be placed in accordance with the manufacturer's lay schedule.

Field connections may be allowed when the main pipe is twice the diameter of the lateral; however, field connections are not allowed when the lateral slope is greater than 10 percent.

## **7. Access Points**

A manhole or inlet with a minimum 36-inch RCP lateral shall be constructed every 500 feet to provide access into the closed system.

## **8. Inlets**

Curb inlets shall be a minimum of 10 feet in length. Recessed curb inlets are required on all concrete streets except local streets. Grate inlets are not allowed on public systems. Drop/Y inlets may be utilized in rear yards to intercept multiple lot to lot drainage or intercept offsite drainage.

## **E. Open System Design**

A development that includes, or is adjacent to a creek, shall submit a hydraulic analysis (flood study) to determine easements and minimum finished floor (MFF) elevations, or to modify existing floodplain or floodway. The requirements for each flood study differ according to the existing creek designation (i.e., within a FEMA

designated floodplain) and whether improvements are proposed for the creek. This section will address the requirements for flood studies.

### **1. Unimproved Creeks (Natural)**

If a developer chooses to leave the creek in its natural undisturbed state, a flood study shall be submitted to determine the easement limits and MFF elevations for the property. The requirements for this type of submittal are included in the Flood Study Matrix in this section.

A drainage easement shall be dedicated containing all land having an elevation below the water surface elevation for the 100-year storm event based on existing conditions or as shown on the FIRM.

Where natural creeks connect to improved systems, permanent transitional materials are required. Additionally, in areas along natural creeks where potential excessive erosion or head cutting may occur, grade control structures, drop structures, or other structures may be required to stabilize the creek. Stabilization materials shall be approved by the Director.

### **2. Improved Open Channels**

If a developer chooses to improve or alter a natural creek, a flood study shall be submitted to the City for acceptance. The study shall define the easement limits and MFF elevations. If the creek is located in a FEMA designated floodplain (Zone A or AE), then the study will be sent to FEMA. Additional hydraulic analyses are required and shall be in accordance with the information outlined in the Flood Study Matrix in this section.

- An improved open channel shall have a concrete-lined bottom, but in no case shall the bottom be less than 8 feet in width. The concrete-lined bottom shall have 6-inch curbs on each side and shall have a bottom thickness of six inches. The concrete-lined bottom shall be at least 3000 psi concrete reinforced with #3 bars on 18" centers. Adequate weep holes shall be provided but in no case shall the weep holes be less than 2" in diameter on 25' spacing. Appropriate filter media shall be provided to protect the weep holes from clogging.
- When the velocity in a proposed earthen channel exceeds 8 feet per second, the City Engineer may require that the side slopes of the channel be lined with concrete, gabions, or another material that will eliminate the potential for erosion.
- In certain instances, a reinforced concrete access ramp may be required for access to improved channels from a public street. The ramp shall be a minimum of 12 feet wide with a maximum slope of 16 percent.
- Earthen channel side slopes shall be a minimum of 4 feet horizontal to 1 foot vertical.

A drainage easement shall be dedicated to include a channel designed to convey the runoff from the 100-year storm plus one foot of freeboard. The drainage easement shall also contain 12 feet on each side of the channel for access and maintenance. Additional easement may be needed at specific locations for access to the feature for maintenance.

Where improved open channels connect to a closed system, natural creeks, or a channel of a different material, a transitional area shall be designed to prevent erosion.

## **F. FEMA Designated Floodplain**

In order to remove all or portions of property from the floodplain, or to improve a creek and construct a channel, a hydraulic analysis must be submitted to the City for acceptance and then to FEMA for approval. There are several types of map changes available through FEMA. The following lists the types of map changes available:

### **1. CLOMA – Conditional Letter of Map Amendment**

A CLOMA is FEMA's concurrence that a proposed structure, upon construction, would be excluded from the Special Flood Hazard Area (SFHA) shown on the effective National Flood Insurance Program (NFIP) map. The letter becomes effective on the date sent. The letter does not revise an effective NFIP map; it indicates whether the project, if built as proposed, will be recognized by FEMA.

### **2. LOMA – Letter of Map Amendment**

A LOMA is an official amendment, by letter, to an effective NFIP map. This is typically used to correct an error on the map and is based on current detailed topographic information. A LOMA establishes a property/structure's location in relation to the SFHA based on natural ground. The letter becomes effective on the date sent.

### **3. CLOMR-F – Conditional Letter of Map Revision Based on Fill**

A CLOMR-F is FEMA's concurrence that a proposed structure/property involving the placement of fill outside of the floodway would exclude an area from the SFHA shown on the NFIP map. The letter becomes effective on the date sent. This letter does not revise an effective NFIP map, it indicates whether the project, if built as proposed, will be recognized by FEMA. The City will only allow a CLOMR-F for small (less than 2 acres), single lot developments where there are no anticipated water surface increases upstream or downstream from the lot.

#### **4. LOMR-F – Letter of Map Revision Based on Fill**

A LOMR-F is an official revision, by letter, to an effective NFIP map. A LOMR-F provides FEMA's determination concerning whether a structure or parcel has been elevated on fill above the Base Flood Elevation (BFE) and excluded from the SFHA. The letter becomes effective on the date sent. The City will only allow a LOMR-F for small (less than 2 acres), single lot developments where there are no anticipated water surface increases upstream or downstream from the lot.

#### **5. CLOMR – Conditional Letter of Map Revision**

A CLOMR is FEMA's concurrence that a proposed project will affect the hydrologic and/or hydraulic characteristics of a channel or creek and thus result in the modification of the existing regulatory floodway or effective base flood elevations (BFEs). The letter becomes effective on the date sent. This letter does not revise an effective NFIP map; it indicates whether the project, if built as proposed, will be recognized by FEMA.

#### **6. LOMR – Letter of Map Revision**

A LOMR is an official revision, by letter, to an effective NFIP map. A LOMR may change flood insurance risk zones, floodplain or floodway boundary delineations, and BFE.

### **G. Flood Study Submittal Requirements**

#### **1. Structures and Property**

In order to remove structures or property from a FEMA designed floodplain, either a LOMA or LOMR-F must be submitted. The MT-1 form is used for CLOMA, LOMA, CLOMR-F, and LOMR-F. To remove an entire lot and structure from the SFHA, both the lowest point on the lot and the lowest floor of the structure must be higher than the 100-year flood elevation. The community must determine that the land and any existing or proposed structures to be removed from the SFHA are "reasonably safe from flooding." Follow the directions for the MT-1 form. The information shall be submitted to the City and upon acceptance will be forwarded to FEMA for approval.

#### **2. Unimproved Creeks and Improved Open Channels**

The following information shall be submitted for all flood studies.

- a. Letter/report from the Engineer that explains the purpose of the study, (i.e., to define easement limits, determine minimum finished floor elevations,

revise the floodplain/floodway, etc.), describes the project and details all information submitted.

- b. Hydrology
  - A current drainage area map
  - A proposed drainage area map, including all offsite area and adjacent subdivisions
  - All hydrology computations and the methods used
  - Channel cross sections showing property lines, easement lines, 100 year floodplain, and floodway.
  - Any other calculations – including verification that the downstream systems (bridges, pipes, bar ditches, etc.) are designed to handle the increased runoff.
- c. Hydraulics
  - A site map showing existing topography and cross section locations
  - A site map showing proposed contours and cross section locations
  - The required HEC runs (see the following sections for details)
  - Corresponding maps for each HEC run submitted.
- d. Submit the flood study in a bound notebook with all pertinent information included. In addition to the above information, an MT-2 form must be filled out and included in the report if the information will be submitted to FEMA.
- e. City Flood Study Review Fee in accordance with the City's Current Fee Schedule.
- f. FEMA Flood Study Fee (if applicable).

### **3. Flood Study Matrix**

Various HEC runs are required to establish criteria set by the City and FEMA. The matrix below is an attempt to clarify which HEC runs are required for the type of creek and improvements proposed. The matrix is divided into creek type (i.e., whether the creek is proposed to remain in its natural (unimproved) condition or be an improved channel. For each type, the creek is further classified as mapped (FEMA designated Zones A and AE), or unmapped. For the specific type and classification of the creek, the following matrix indicates the HEC runs that are required with the Flood Study submittal. Additional HEC runs may be required depending on the analysis.

Flood Study Matrix							
		City		FEMA			
	FEMA Class	1	2	3	4	5	6
Unimproved Creeks	Mapped Zones A & AE	x	x				
	Unmapped	x	x				
Improved Open Channels	Mapped Zone A	x	x			x	x
	Mapped Zone AE	x	x	x	x	x	x
	Unmapped	x	x				
<u>HEC Runs</u> Type 1: 25-year fully developed conditions model Type 2: 100-year fully developed conditions model Type 3: Duplicate effective model Type 4: Corrected effective model Type 5: Existing or pre-project conditions model Type 6: Revised or post-project conditions model							

Unimproved Creeks (Natural)

The following HEC runs are required when a natural creek is mapped or unmapped. The information will not be submitted to FEMA.

- HEC analysis based on the 100-year storm event for a fully developed watershed. This information will be used to define the minimum finished floor (MFF) elevations and the easement limits.

Improved Open Channels (Earthen/Concrete)

The following HEC runs will be required when the development changes the FIRM maps or cross sections of the creek significantly. Some of the information will be submitted to FEMA (CLOMR/LOMR).

The following information is required by the City for all mapped or unmapped creeks. This information will not be submitted to FEMA.

- HEC analysis based on the 100-year storm event for a fully developed watershed. This information will be used to define the MFF elevations and the easement limits.

The following HEC models are required and will be sent to FEMA for review if the creek is within Zone A:

- HEC model based on existing or pre-project conditions – to reflect current conditions prior to the construction of the project using current cross

sections and flows from development within the drainage area since the date of effective model.

- HEC model based on revised or post-project conditions – based on current flows plus additional flow caused by the development.

The following additional HEC models are required and will be sent to FEMA for review if the creek is within Zone AE:

- Duplicate Effective Model – model used in the effective Flood Insurance Study (can be obtained from FEMA).
  - Corrected Effective Model - corrects any errors that occur in the duplicate effective model, adds cross sections, or incorporates more detailed topographic information.
4. It is the responsibility of the owner to obtain all required local, state and federal permits including, but not limited to, the Corps of Engineers Permit. The City may require documentation of coordination with any state or federal agency.

## H. Drainage Easements

### 1. Unimproved Creeks

The minimum easement is the 100-year fully developed floodplain.

### 2. Improved Open Channels

The minimum easement is the width of the channel, which shall hold the runoff from the 100-year storm for fully developed conditions plus one foot of freeboard. An additional 12 feet shall be dedicated on either side of the channel for access and maintenance.

## I. Bridges and culverts

All bridges and culverts shall be designed in accordance with the current edition of the *Hydraulic Design Manual* prepared by the Texas Department of Transportation. All culverts shall have headwalls and wingwalls upstream and downstream. All culverts shall pass the fully urbanized 100-year frequency storm runoff without allowing runoff to pass over the road. All bridges shall have channel bottom and sloped concrete lining. The low point on the bridge or culvert structure shall be at least two feet above the ultimate 100-year water surface elevation.

## J. Storage (Detention/Retention)

Storm water storage may be designed and constructed with any development if located in an area where any of the following situations exist:

- The release rate of storm water runoff from the proposed development exceeds the capacity of the existing downstream drainage system.

- The development will create structural (building) flooding or significantly worsen known structural (building) flooding.

The storage and release rates shall be evaluated for the 5-year and 100-year storm events. The release velocities shall be designed to minimize erosion downstream of the facility. A minimum of one foot of freeboard shall be provided.

All above ground facilities that store more than a total depth of four feet shall be designed to meet all state and federal criteria for small dams.

Acceptable design methods include the Dallas and NCRS methods.

Detention/Retention facilities that serve more than one lot must be contained within a private drainage easement and a maintenance statement must be placed on the plat in accordance with the Subdivision and Development Ordinance. If the plat for the development has already been filed without the private drainage easement, the private drainage easement must be filed by separate instrument and a maintenance statement must be included with the dedication statement.

#### **K. Positive Overflow**

Positive overflow shall be evaluated for the entire development. Positive overflow means conveying the difference between the 100-year flow and the design frequency flow in a secondary drainage feature without flooding structures. The secondary drainage feature shall be a flume or other permanent facility authorized by the Public Works Director with a minimum width of four feet. A drainage easement shall be dedicated between lots at or near the low point in the street to allow for positive overflow systems. Flumes shall be constructed in accordance with the section below.

#### **L. Flumes**

Flumes constructed between lots or visible from a street shall be constructed with alternative materials or finishes in lieu of traditional reinforced concrete to soften the appearance. Examples of acceptable alternatives are colored concrete, exposed aggregate concrete or concrete pavers. Other alternatives may be submitted with the construction plans and will be evaluated for acceptance.

Flumes are not allowed in lieu of an underground drainage system without approval of the DPW.

#### **M. Concentrated Runoff from Development**

In areas where concentrated runoff leaves the development, the following information shall be provided:

- The 5-year and 100-year design discharges.
- The depth of inundation of these discharges.
- The impacts on existing and proposed facilities for the 100-year discharge.

Upon analysis of the information submitted, the owner may be required to provide facilities to address negative impacts from the 100-year discharge.

Where drainage features such as storm sewer systems, ditches, channels, and natural creeks are available to receive concentrated runoff, the design storm shall be collected on-site and connected to the feature.

When offsite grading is required or the development discharges concentrated flow on an adjacent property, a Notarized Letter of Permission from the affected property owner(s) shall be required. The letter shall state that the permission binds all future owners of the property and shall be a covenant running with the land. It shall also reference the subdivision plans. The letter shall be filed with the county by the City. A letter of permission template may be found in Appendix O.

## **N. Site Grading**

An engineered overall site grading plan shall be submitted with the subdivision's paving and drainage plans. The plan shall be consistent with the drainage area map. The plan shall include flow arrows, spot elevations and/or proposed contours. Type 1 or 2 block grading as shown in the HUD (FHA) Data Sheet 72 (Appendix J) is preferred. Type 3 and 4 block grading is allowed only if:

- a flume, channel or underground drainage system is constructed at the rear of the lot to intercept runoff; or
- runoff from no more than 3 lots is accumulated prior to constructing an underground drainage system, flume or channel to intercept the runoff.

The engineer may utilize berms and swales to redirect flows. Grass swales shall have a minimum of 1 percent slope. Retaining walls may be used to direct flow. All retaining walls shall be permitted through the Building Inspections Division.

If the site is complex and an overall site grading plan cannot be developed in accordance with the HUD standards, an individual grading plan for each lot shall be submitted by an engineer prior to issuing the building permit. The individual grading plans shall be coordinated with surrounding lots and the drainage area map for the subdivision. For these complex plans, an "as-built" letter shall be submitted by an engineer prior to final inspection.

## **O. Minimum Finished Floor Elevation**

The City reserves the right to require minimum finished floor elevations on any lot. Minimum finished floor elevations are required for all lots located in the floodplain or near open drainage features and shall be set one foot above the 100-year fully developed water surface elevation. MFF elevations may also be required at T-intersections, low points, or as required by the subdivision design. These elevations are typically set 1 foot above the top of curb. Elevation certificates will be required for lots impacted by the floodplain. Refer to the FEMA website for the most current version.

When minimum finished floors are required, a letter from a Registered Public Land Surveyor shall be provided to the City stating the floor elevation. This letter shall be provided prior to placement of the concrete slab.

**P. Miscellaneous**

**1. Valley Gutters**

Transverse valley gutters are not allowed in lieu of an underground drainage system without approval from the DPW. Where approved, the valley gutter shall be a minimum of 8 feet in width for the full width of the street and constructed of reinforced concrete. The street crown transition shall be a minimum of 25 feet in both directions.

**2. Temporary Tie-ins to County-type Roadways**

Tie-ins to existing county-type roadways planned for future improvements are considered temporary. Culverts under driveways and roadways shall be a reinforced concrete pipe and a minimum of 18 inches and designed to carry the 5-year storm. The driveway or roadway shall also have an invert above the pipe for positive overflow and safety end treatments. If the driveway or roadway is located in an area of shallow bar ditches and a culvert is not feasible, the driveway or roadway shall be constructed with an invert.

**3. Private Drainage Improvements**

Private drainage improvements shall be designed in accordance with City standards and shall meet the minimum construction standards for public drainage facilities. Inspections of private facilities shall be performed by the City at the owner's expense at the rate set by the City Council.

## SECTION 4.7 FIRE ACCESS REQUIREMENTS

### A. Construction Requirements

To provide adequate emergency vehicle access, all required fire lanes and public streets shall be installed and accepted before any construction occurs above the slab.

### B. Hose Lay Distance

All buildings or structures shall be constructed such that all ground level, exterior sides of the building are within 150 feet of a dedicated street or fire lane. The 150 feet is measured by an approved route around the exterior of the building or facility. If the 150 feet cannot be reached from a public street, a fire lane will be required on site. This distance may be extended to 200 feet for single-family dwellings with approval of the Fire Marshal. Except for single or two-family residences, the path of measurement shall be along a minimum of a ten (10) feet wide unobstructed pathway around the exterior walls of the structure.

### C. Unusual Conditions

When fire lanes cannot be installed due to topography, waterways, non-negotiable grades or other similar conditions, the Fire Marshal may require additional fire protection systems.

### D. Surface

Fire lanes shall be constructed of a 6" reinforced concrete to provide all-weather driving capabilities, meeting the requirements of the standards contained within this manual and the adopted Fire Code.

### E. Vertical Clearance

All fire lanes shall have a minimum vertical clearance of 14 feet to allow a fire truck to pass under.

### F. Width

The minimum unobstructed width of a fire lane shall be 24 feet to allow two fire trucks to pass in case of an emergency. For one single-family dwelling, this width may be reduced with approval of the Fire Marshal.

### G. Turning Radius

All fire lanes shall have a minimum inside turning radius of 30 feet and an outside turning radius of 54 feet.

**H. Grade**

The maximum grade for a fire lane or street when serving a building not protected throughout by an automatic sprinkler system is 10 percent.

**I. Bridges**

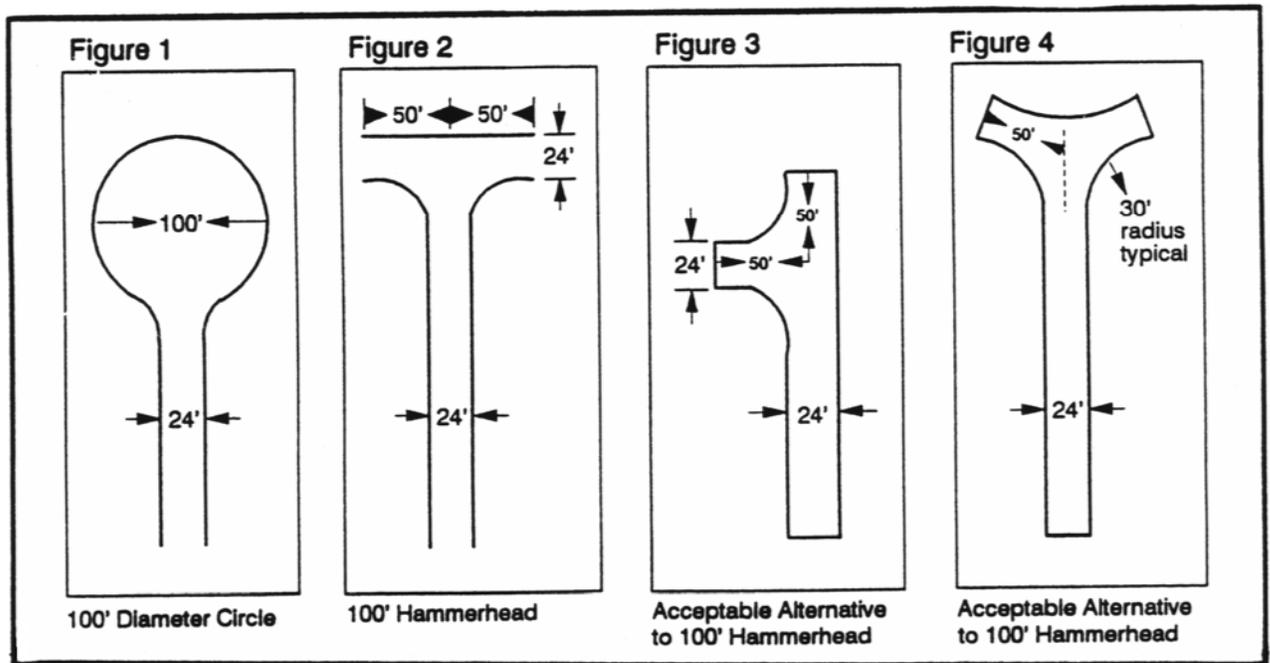
When a bridge is required to be used as access, it shall be constructed and maintained to carry a load of 75,000 pounds.

**J. Gates**

All gates across streets or fire lanes must be approved by the Fire Marshal and DPW. Plans shall be submitted to the Fire Marshal and DPW and approved prior to a permit being issued. All gates across fire lanes shall be equipped with a Knox entry system. A call box shall be required for all gates.

**K. Turn-Around Areas**

Dead-end fire lanes shall not exceed 150 feet in length without an approved turn around. Illustrations of approved turn-around arrangements are as follows:



**L. Obstruction**

The required fire lane width shall not be obstructed by parked vehicles or other obstructions. Speed bumps or similar obstacles that have the effect of slowing or impeding the response of fire apparatus shall be approved by the Fire Marshal prior to installation.

## **M. Striping**

In general, residential streets constructed to the standards contained herein are not required to be striped as fire lanes. However, there may be certain instances where narrow roads are constructed or there is a concern with excessive parking on the street, where the Fire Marshal may require fire lane striping. If fire lane striping is required, the fire lane shall be marked by painted lines of red traffic paint six inches (6") in width to show the boundaries of the lane. The words "NO PARKING FIRE LANE – Tow Away Zone" or "FIRE LANE NP PARKING – Tow Away Zone" shall appear in (4") white letters at 25 feet intervals on the red border markings along both sides of the fire lanes. Where a curb is available, the striping shall be on the vertical face of the curb.

## **N. Signs**

Signs may be substituted for fire lane striping in residential areas with approval of the Fire Marshal. If signs are required, they shall read "NO PARKING FIRE LANE" or "FIRE LANE NO PARKING" and shall be twelve (12) inches wide and eighteen (18) high. Signs shall be painted on a white background with letters and borders in red, using not less than two (2) inch lettering. Signs shall be permanently affixed to a stationary post and the bottom of the sign shall be six (6) feet, six (6) inches above finished grade. A companion "Tow-Away Zone" sign shall be placed directly under this sign. The sign shall read "Tow-Away Zone" and shall be twelve (12) inches wide and six (6) inches high. Signs shall be painted on a white background with letters and borders in red, using not less than two (2) inch lettering. Signs shall be spaced not more than fifty (50) feet apart. Signs may be installed on permanent buildings or walls as approved by the Fire Marshal.

## **O. Maintenance**

All designated fire lanes shall be maintained by the owner or the homeowners association at all times.

## SECTION 4.8 CONSTRUCTION REQUIREMENTS

### A. Fill

Grading prior to the issuance of a CFC and fill placed within the right-of-way shall follow the requirements in 3.9.B of the Design Standards Manual.

### B. Construction Responsibility

The owner shall be responsible for all improvements required for the development of the subdivision, including any necessary offsite facilities and construction staking. If construction is not feasible at the time of site development, the owner may request to escrow the costs with the City. The escrow amount shall be equivalent to the owner's share of the construction cost plus actual engineering cost, plus any cost for right-of-way or easements, plus the cost for utility relocation. The City shall determine whether escrow will be accepted in lieu of construction. The escrow shall not be subject to refund.

### C. As-built Plans

Once the subdivision is initially accepted, the owner's engineer shall furnish the City with one mylar set and two paper sets of as-built drawings and electronic files of the plans. The as-built drawings shall be clearly marked as such.

The owner's engineer shall furnish the City an electronic file of the construction drawings in AutoCAD R14 or higher in .DXF or .DWG format. The information shall be provided to the City on CD-ROM. The following layer names shall be used:

DATA	LAYER NAME
Water Lines	C-WTR-WL
Water Line Text	C-STR-WL-TXT
Water Line Valves	C-WTR-GV
Water Line Valve Text	C-WTR-GV-TXT
Water Line Fire Hydrants	C-WTR-FH
Water Line Fire Hydrant Text	C-STR-FH-TXT
Sewer Lines	C-SWR-SL
Sewer Line Text	C-SWR-SL-TX
Sewer Lines Cleanouts	C-SWR-CO
Sewer Lines Cleanout Text	C-SWR-CO-TXT
Sewer Lines Manholes	C-SWR-MH
Sewer Lines Manhole Text	C-SWR-MH-TXT
Closed storm sewer system	STORM
Back of curb	CURB
Right-of-way	ROW
Edge of sidewalk	SIDEWALK
Open storm sewer systems	CHANNEL

All files shall be in the same directory, including all construction documents with their dependencies (XREFS), plot files, and any support files needed. The electronic files shall use only standard AutoCAD fonts with "ROMANS" as the main font.

#### **D. Private Facilities**

Prior to acceptance of private improvements, an as-built letter sealed, signed, and dated by the design engineer shall be submitted certifying that the facilities were constructed in accordance with the accepted plans.

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